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ERD Working Paper SERIES No. 92

ECONOMICS AND RESEARCH DEPARTMENT

Measuring Underemployment: Establishing the Cut-off Point

Guntur Sugiyarto

March 2007

Asian Development Bank

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March 2007
ISSN 1655-5252

FOREWORD

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ABSTRACT

Unemployment and underemployment are the most pressing problems in Asia today, which is reflected in the widespread underutilization rate of about 29% of the total labor force. In addition to the fact that most of the labor force in developing countries cannot afford to be completely unemployed, the standard labor force framework currently in use worldwide is biased toward counting labor force as employed rather than as unemployed. This systematically undervalues the full extent of the unemployment problem. This paper suggests a better way to determine the threshold to measure underemployment using the cluster method. The robustness of its results is assessed using ANOVA tests, Chow test, and recursive dynamic regressions. Overall, results indicate that the proposed cut-off point of 40 working hours per week is the best one.

I. INTRODUCTION

A. Background

Unemployment and underemployment are the most pressing problems in Asia today. Using various estimates, out of a 1.7 billion labor force, around 500 million are either unemployed or underemployed (ADB 2005). This reflects an underutilization rate of about 29% of the total labor force. The underutilization problem shown by the statistic might, however, just be the tip of the iceberg since higher underutilization could have been detected if a better measure of unemployment and underemployment were used.

To start with, the standard labor force framework (LFF) currently in use worldwide may not necessarily be always appropriate for developing countries. The LFF defines working as conducting economic activities for at least one hour during a reference period. This working concept encompasses all types of employment situations: formal, informal, casual, short-time, and all forms of irregular jobs. Accordingly, during the reference period,[1] the worker could be working in self-employment,[2] family business, business enterprise, or even temporarily not working for a number of acceptable reasons.[3] On the other hand, the unemployed comprises those who are not working, are available for work, and looking for a job. The employed and unemployed constitute the labor force.

The LFF seems very straightforward but its implementation across countries varies considerably. Moreover, its implementation in developing countries has resulted in unemployment figures that many believe to be too low to represent reality. The LFF is criticized for being essentially biased toward counting a person as employed rather than as unemployed. As a result, it systematically undervalues the full extent of the unemployment problem. This situation is indeed unfortunate given that the LFF was introduced in the 1950s to rectify the very same problem encountered by the previous approach of "gainfully working", in which a working-age individual is classified as gainfully or not gainfully working depending on whether he/she has a profession, an occupation or trade, but with no specifications for time reference and proof of existence of working activity. Box 1 summarizes this issue in more detail.

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[1] The reference period of a labor force survey is usually one week prior to a survey date.

[2] Employers, own-account workers, and unpaid family workers are considered as self-employed.

[3] Persons temporarily not at work because of illness or injury; holiday or vacation; strike or lock-out; educational or training leave; maternity or parental leave; reduction in economic activity; temporary disorganization or suspension of work due to such reasons as bad weather, mechanical or electrical breakdown, or shortage of raw materials or fuels; or other temporary absence with or without leave should be considered as in paid employment provided they have a formal job attachment.

Box 1
Development of the Labor Force Framework

Measuring labor utilization is important for at least two reasons: first, labor is a productive input that cannot be stored and should not be wasted; and second, ownership of productive inputs determines income, and many people in developing countries have only labor as their income source.

There have been different approaches used for measuring labor utilization. The gainful worker approach (GWA) was first used in the United States until the depression in 1930s. A new approach was then needed as unemployment and underemployment became pressing problems that could not adequately be measured by GWA. Accordingly, the labor force framework (LFF) was introduced. By 1950, both approaches were made available by the United Nations to all countries, but by 1970, the United Nations through its World Census Program abandoned the former approach and pushed for the use of the latter.

In GWA, a working-age individual, minimum 10 or 15 years old, is classified as gainfully or not gainfully working depending on whether he/she has a profession, an occupation, or trade. There is no time reference specified in this approach, nor is proof required for existence of any working activity. Accordingly, the approach may systematically underestimate unemployment by counting those with a profession, an occupation, or trade but already retired/without work as gainfully working.

On the other hand, the LFF is based on economic activity criteria rather than economic status. In this concept, a working-age individual is classified as working if he/she has conducted an economic activity for at least one hour during the reference period. For those who are not working and looking for a job, they are classified as unemployed. The employed and unemployed constitute the labor force. Therefore, the working-age population can be classified as either labor force or nonlabor force.

Another main reason for the understated unemployment problem above is because most of the labor force in developing countries simply cannot afford to be completely unemployed. They must take on whatever job is available to sustain their living. This is very different from the notion of "'having a job"' or "'working"' in developed countries, in which the job in general really pays, providing a guarantee for a decent standard of living. In addition, the absence of unemployment benefits and the general condition of households in developing countries—with their low income and saving—further strengthen the case that most people in developing countries simply cannot afford to be voluntarily unemployed. In this context, therefore, a comparison of unemployment rates between developed and developing countries could be problematic given their different natures of employment and unemployment. This is true even if they use of the same concept and definition of employment and unemployment. Moreover, there is also a statistical reason that the rates are calculated from different labor force surveys, which have different scope and coverage, concept and definition of variables, and survey's reference period. This will make their results less comparable. Box 2 further highlights some conceptual problems in the LFF.

BOX 2
CONCEPTUAL PROBLEMS IN THE LABOR FORCE FRAMEWORK

The LFF provides a comprehensive and consistent system of classifying the working-age population. However, the types of labor utilization included in the approach are more suited to the modern sectors in developed countries. Accordingly, the approach may not adequately capture labor utilization in developing countries, where the economy is still characterized by large agricultural and informal sectors (Myrdal 1968, Hauser 1974, NSO 2007).

An additional problem lies in the LFF implementation. Results of classifying individuals into different categories of employment depend on the types and structure of the questions used in the survey, instructions to enumerators, data collection procedures, data processing, and other factors. There is also a lack of expertise and resources to undertake labor utilization measurement in developing countries. In some cases, conducting labor force surveys on a regular basis is even difficult in some countries.

Myrdal (1968) further highlights the inapplicability of the labor force approach to developing countries. The framework does not distinguish between labor reserve and readily available labor surplus, and measures labor underutilization only in terms of readily available surplus as described by unemployment and underemployment. In some developing countries, the labor reserve is larger than the readily available surplus, therefore the extent of idleness or underutilization is greater than what is measured by the labor force approach. Accordingly, the problem of labor underutilization is not only unemployment and underemployment but also the presence of idle labor reserve. This implies that the full employment of labor will require a set of policies that will change attitudes and institutions with regard to employment and work.

B. Why an Underemployment Indicator is Needed

To overcome the problem of understated open unemployment highlighted above, an underemployment indicator is introduced. The main purpose is to derive more representative indicators of underutilization by complementing the open unemployment indicator with an underemployment indicator. As in the case of open unemployment, a higher underemployment level indicates a more serious employment problem, and vice versa. In this context, it is implicitly assumed that the underemployed also needs a job, a "better" job. There is also a good reason to combine the open employment and underemployment indicators since both represent underutilization of the labor force. ADB (2005), for instance, shows how the two indicators are combined to show the underutilization trend in the Philippines. Box 3 summarizes some alternative approaches of the labor force framework.

The resolution concerning statistics on economically active population, employment, unemployment, and underemployment adopted by the 13th International Conference of Labor Statisticians in October 1982, stipulated that each country should develop a comprehensive system of statistics on economic activity to provide an adequate statistical base for various users. In doing so, each country should consider the specific national needs and circumstances for both short-term and long-term needs. The economically active population comprises all persons providing the supply of labor for the production and processing of economic goods and services for the market, for barter, or for own consumption.

More specifically, the resolution concerning the measurement of underemployment and inadequate employment situations, adopted by the 16th International Conference of Labor Statisticians in October 1998, concluded that statistics on underemployment and indicators of inadequate employment

situations should be used to complement statistics on employment, open unemployment, and inactivity, including the circumstances of the economically active population in a country. The primary objective of measuring underemployment and inadequate employment situations is to improve the analysis of employment problems and to contribute toward formulating and evaluating short-term and long-term policies and measures designed to promote full, productive, and freely chosen employment. This was specified in the Employment Policy Convention (No. 122) and Recommendations (No. 122 and No. 169) adopted by the International Labor Conference in 1964 and 1984. The main issue here is how to define and then measure underemployment.

Box 3
Alternative Approaches to the Labor Force Framework

There have been a number of alternative approaches attempted to remedy the deficiencies of the labor force approach. Myrdal (1968) outlined an alternative approach to labor utilization measurement in developing countries by measuring the difference between total labor input of the labor force with complete participation at an assumed standard of work duration, and labor input from actual participation expressed as a ratio of the former.

Another alternative approach was developed by the Organization of Demographic Associates (ODA) in Southeast Asia. The ODA approach involves classifying the working-age population into four categories: working for wages or profit, working outside the household without monetary payment, working inside the household without monetary payment, and others. These categories are then further classified into work type subcategories. In addition, the categories and subcategories are subdivided into agriculture and nonagriculture. Therefore, three criteria are used to classify the working-age population, namely (i) working in the monetary or nonmonetary sector, (ii) inside or outside the household, and (iii) agriculture or nonagriculture (Hauser 1974).

Oshima and Hidayat (1974) suggested a different approach for labor utilization measurement for an economy characterized by labor shortage and/or labor surplus. In countries beset by labor shortage, an employment status survey that discriminates those with and without jobs would give more information on the employed. In the labor-surplus developing countries, an unemployment status type of survey would be more appropriate to capture the different dimensions of labor underutilization.

Hauser (1974) proposed a measure of labor underutilization in developing countries by classifying the workforce into those utilized adequately and those inadequately. The latter is classified further by its cause of underutilization, namely, unemployment, inadequate work hours, inadequate income, and mismatch of occupation and education/training. The adequately utilized workers are the residual of the total work force. This classification reveals better the extent of underutilization and its dimensions. This is very important since each underutilization type may require different policy interventions. Labor underutilization due to unemployment and inadequate working hours may require job creation. However, underutilization due to inadequate income would call for policies in human resource development and production technology improvements. The mismatch case would require policy rationalizing, individual skill formation decisions both in the formal and informal education sectors, and human resources planning.

C. Main Purpose of the Paper

This paper examines how the cut-off point used in determining underemployment can be very critical in the resulting indicator and therefore in its policy implications. The cut-off point is critical because there are many workers working around the cut-off point such that a small change in the cut-off point will result in a much bigger change in the resulting indicator. Therefore, it is very important to derive the right cut-off point to reduce the risk of undermining the underemployment problem.

Theoretically, the cut-off point should be determined in such a way that it can significantly differentiate two groups of underemployed and fully employed with regard to some important characteristics relevant to both groups. This study tries to make a contribution in this area by demonstrating how the cut-off point can be determined in a more systematic way, i.e., by employing a clustering method to determine the "theoretically suggested" cut-off point. The clustering is based on a monthly wage variable, which is selected as the most important determinant variable of working hours. The study uses the labor force survey data of Indonesia in 2003 (Sakernas 2003; see BPS 2003).

The grouping result of underemployed and fully employed workers using the cluster method is compared with the results of grouping using cut-off points of the International Labour Organisation (ILO) and the Central Board of Statistics (BPS). The comparison is conducted by employing a statistical test of cross tabulations based on relevant variables. Furthermore, determinant function analysis and econometric method are used to further highlight why the results of using the cluster method is superior to both ILO and BPS approaches. A more comprehensive way of classifying underemployment using the regression method on the determinant variables is also explored in this study.

II. DEFINITION AND MEASUREMENT OF UNDEREMPLOYMENT

A. Defining Underemployment

Underemployment is a situation wherein a worker is employed but not in the desired capacity, i.e., in terms of compensation, hours, skill level, and experience. Hence, employment is inadequate in relation to a specified norm or alternative employment. There are two principal forms of underemployment: visible and invisible underemployment. Visible underemployment is a statistical concept reflecting insufficiency in the number of employed. The indicator of visible underemployment can be developed using results of labor force surveys and other surveys. Invisible underemployment, on the other hand, is primarily an analytical concept reflecting a misallocation of labor resources, evidenced by a worker's low income and productivity and underutilization of skill.

From a slightly different view, underemployment can take four forms: working less than full time, having higher skills than needed by the job, overstaffing, and having raw labor with few complimentary inputs (ADB 2005). Along this line, Hauser (1974 and 1977) developed a labor utilization framework to better measure underemployment that includes six underemployment components (see Box 4).

From a theoretical perspective, the standard theory of labor supply suggests that individuals will choose their optimal number of hours, and that employment opportunities are likely to be distributed across the working hours. This suggests that underemployment is not a persistent issue. Empirical evidence, however, suggests otherwise, as due to various reasons, there are some rigidities in the number of working hours that workers would like to work. Accordingly, time-related underemployment has become an important issue.

Box 4
Labor Utilization Framework

The labor utilization framework (LUF) of Hauser (1974 and 1977) seeks to address the underemployment issue and has six components, namely:

(i) ***Sub-unemployed (S)***. This is the discouraged workers or job seekers category, and represents the most serious type of underemployment. Included in this category are those who are not working and not looking for jobs for the main reason of "unable to find a job" or "discouraged." (In the new ILO definition of unemployment, these discouraged job seekers are included in the new definition of unemployed. See Sugiyarto et al. 2006 for a discussion on this as well as on its impact on the unemployment indicator in Indonesia.)
(ii) ***Unemployed (U)***. This represents the unemployed calculated using the standard labor force approach, and covers those who are not working and are looking for work.
(iii) ***Low-hour workers (H)***. This includes workers who are involuntary working part-time or who work less than the normal working hours.
(iv) ***Low-income workers (I)***. This includes workers whose work-related income is less than the minimum social requirement, i.e., less than 1.25 times the poverty line for an individual.
(v) ***Mismatched workers (M)***. Mismatched workers can be a result of being overeducated compared to what is typically required in relevant occupations, i.e., years of schooling is more than one standard deviation above the mean schooling years required for relevant occupations.
(vi) ***Adequately employed (A)***.This is a residual measure indicating those not belonging to any of the above five categories.

All the six LUF components are mutually exclusive and exhaustive, so that any individual in the labor force can only be classified into one and only one type of classification. The first component of sub-employment has sometimes been excluded from the labor force and therefore from the LUF. A comparison of LFF and LUF is summarized in Box Table 1.

Box Table 1
A Comparison of Standard Labor Force and Labor Utilization Frameworks

Standard Labor Force Framework	Labor Utilization Framework
Total labor force	Total workforce
Employed	Utilized adequately Utilized inadequately by: —Hours of work —Income level —Mismatch of occupation and education
Unemployed	Unemployment

Source: Adapted from Hauser (1974).

B. Measuring Underemployment

1. Conceptual Issues

For operational reasons, the statistical measurement of underemployment is commonly limited to visible underemployment. This can be measured by calculating the number of underemployed and the quantum of underemployment. The underemployment indicator can be represented as a ratio of the number of underemployed to the number of workers or the total labor force. The latter becomes the underemployment rate. The quantum of underemployment, on the other hand, can be measured by aggregating the time available for additional employment of the underemployed workers.

The resolution concerning the measurement of underemployment and inadequate employment situations, adopted by the 16th International Conference of Labor Statisticians in October 1998, further recommended that measurements of underemployment be limited to time-related underemployment, which is defined as all persons in employment who satisfy the following three criteria of (i) working less than a threshold relating to working time, (ii) willing to work additional hours, and (iii) available to work additional hours. In this context, the underemployed comprise all workers who are involuntarily working less than the normal duration of work determined for the activity, and seeking or available for additional work. The normal duration of work for an activity (normal hours) should be determined in the light of national circumstances as reflected in national legislation to the extent it is applicable; in terms of usual practices in other cases; or in terms of a uniform conventional norm.

The normal hours are the hours worked before overtime payments are required. The normal hours can function as a ceiling on hours worked to deter excessive hours of work, or as a medium to obtain higher wages.

Most labor laws mandate statutory limits on working hours. The initial working hour standard adopted by the ILO[4] mandates a maximum of normal working hours of 48 hours per week. The more recent approach at the international level[5] is the promotion of 40 hours per week as a standard to be realized, progressively if necessary, by ILO member states (McCann 2005). The ILO research reveals that 40 hours per week is now the most prevalent weekly hour standard. Almost half of 103 countries reviewed in the ILO report have adopted 40 hours per week or less (ILO 2005).

The working hour limit is initially intended to ensure a safe and healthy working environment and adequate rest times. The limit has also become a way of advancing additional goals of allowing workers to balance their paid work with their family responsibility and other aspects of their lives, promoting productivity and reducing unemployment.

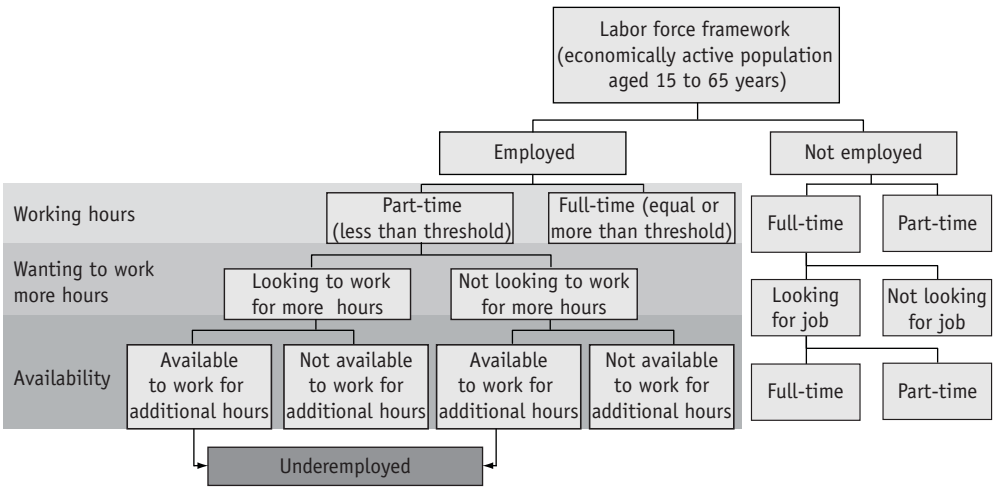
Figure 1 shows the ILO strict framework for measuring underemployment, complete with the three underemployment criteria. Examining the framework, there might be some conceptual problems in measuring underemployment. First, the question of "looking to work for more hours" might be interpreted as only looking for more working hours from the existing jobs, excluding looking for additional or even a completely new job. Second, there is no strict guideline on what availability means. As in the first point, availability can refer to available for more working hours only, or

[4] The hours of Work (Industry) Convention, 1919, No 1; and the hours of work (Commerce and Offices) convention, 1930, No. 30.

[5] Reflected in the Forty-Hour Week Convention, 1935, No 47; and the reduction of hours of work recommendation, 1962, No. 116.

available for additional or new jobs. Third, the reference period for availability can refer to the survey's reference period or to the near future such as the next week or month. Most labor force surveys refer availability to work during the surveys' reference period, while the practice in the United Kingdom and other European countries (see, for example, Simic 2002) shows that availability in fact refers to period after the survey. The different reference periods will of course produce different results of underemployment.

Figure 1
The ILO Labor Force Framework for Measuring Underemployment



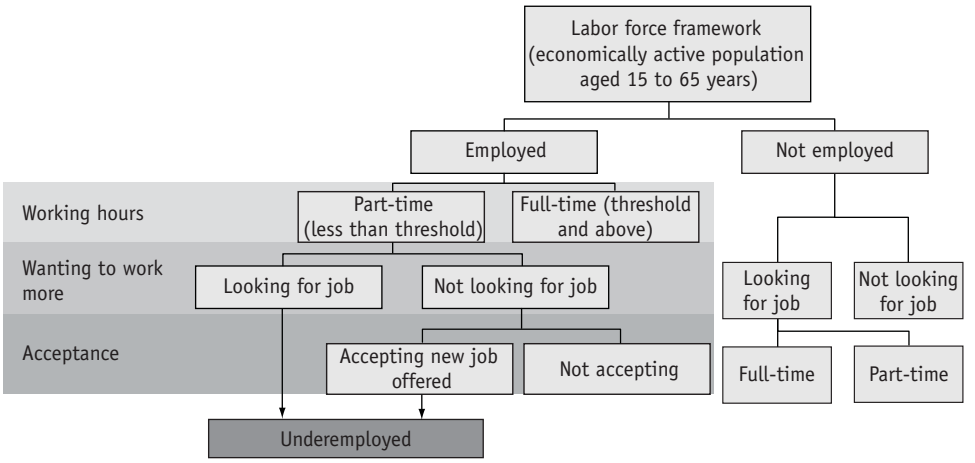
Source: Adapted from Hussmanns et al. (1990).

The ambiguity of the guideline at the conceptual level can have significant impacts on the underemployment indicators. Worse still, various countries interpret the guideline differently in implementing the LFF, including on aspects that might be considered very obvious.

Figures 2 and 3 show how the ILO guideline can strictly be implemented in Indonesia and the Philippines. Given the existing labor force surveys in the two countries, their underemployment indicators will not be strictly comparable even at the conceptual levels. Moreover, both indicators are also inconsistent with the ILO framework.

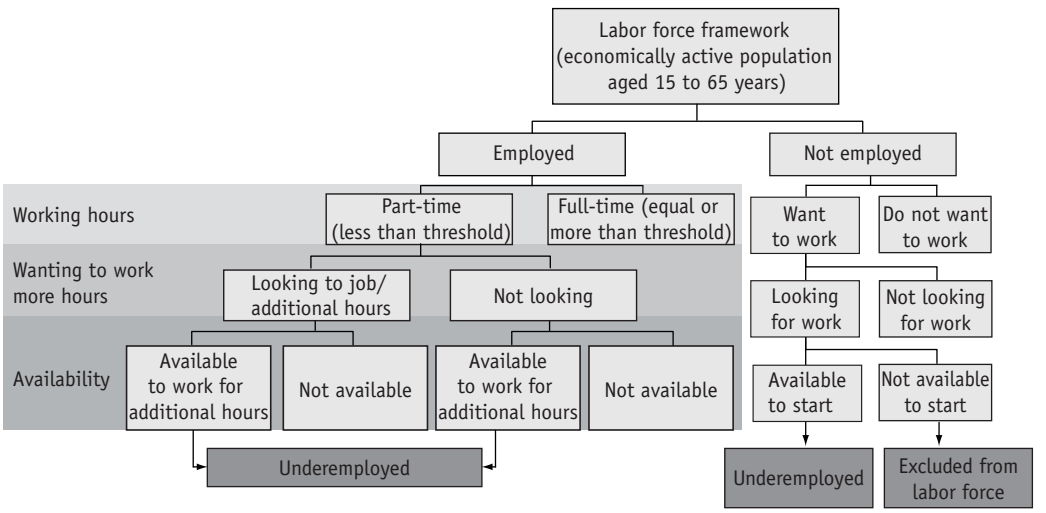
The Indonesian and Philippine frameworks have their own issues that make them strictly incomparable. Among the three criteria used for classifying underemployed, only the number of working hours is relatively comparable. The other two criteria of availability and willingness to work more have been interpreted differently in the two countries, making their indicators inconsistent. This case is not unique for Indonesia and the Philippines; it also creates difficulty in deriving a consistent underemployment indicator across other countries. A close examination of the existing labor force surveys in the developing countries reveals that a strict implementation of the ILO definition on underemployment based on the LFF would be very difficult. In fact in some cases, strict implementation is even impossible without imposing very strong assumptions about working hours, wanting to work more hours, and availability for additional jobs.

Figure 2
Indonesian Framework for Measuring Underemployment



Source: Adapted from the Indonesian *Labor Force Survey* (SAKERNAS 2003; see BPS 2003).

Figure 3
Philippine Framework for Measuring Underemployment



Source: Adapted from the *Labor Force Survey Manual* (NSO 2007).

In the Indonesian framework, for instance, the criteria of "wanting" and "available" to work more are not explicitly accommodated in the questionnaire. Instead, they are embedded in the question of "looking for job." In this context, it is implicitly assumed that those looking for a job must be wanting and available to work. This assumption is unfortunately not always true. "Looking" and "available to work" could in fact be completely independent, even if their reference periods are the same. People might be looking for a job now but not available to work straightaway. The measurement of open unemployment in the Philippines, which is also presented in Figure 3, provides

a good example on this issue as those who are not working and looking for jobs are not automatically classified as unemployed like in most other countries. Instead, they must also be "available to work" at the same time to be classified as unemployed. If they turn out to be not available to work during the reference period then they are not only excluded from the unemployed group but also excluded from the labor force. There are a significant number of people in the Philippines who are excluded from the labor force because of this reason, i.e., they are not working and looking for a job but they are also not available to work. They could be unemployed looking for a job but still waiting for something else such as receiving a qualification certificate, graduation, and so on, hence they cannot start working immediately. A quick cross tabulation of the Philippine labor force survey in 2005 results in about 0.3 million people in this category.

Two more problems can still be identified from the Indonesian framework that can systematically understate its underemployment indicators. First, the question of "looking for a job" among workers can be interpreted as looking for a new job only, excluding looking for more working hours from the existing job. Second, as there is no question on availability to work more, the question on willingness to accept a new job offer can be used as a proxy. Unfortunately, this question is only for those who are not looking for a job. Therefore, it cannot be used.

The Philippine framework follows closely the ILO guidelines. In fact, it goes a step further by combining both looking for a job and more working hours into one question. Therefore, those looking for a new job, an additional job, and more working hours are included already in the underemployed. The question on availability to work is, however, referred to as the last two weeks prior to the survey date.

2. Practical Problems

In practice, the complete recommendation on how to measure underemployment is rarely used. The last two underemployment criteria of "looking" and "available" to work are hardly ever used. As a result, most underemployment indicators are calculated based only on working less than a threshold related to working time, i.e., working hours below the cut-off point for a fully employed worker. Moreover, the practice of determining the cut-off point in many countries is mostly inconsistent with the guideline that the cut-off point should be determined by considering national circumstances, usual practices, or a uniform conventional norm. In reality, the cut-off point is determined in a less methodical way or even somewhat arbitrarily with no explanation on how and why the cut-off point is chosen.

Therefore, most underemployment indicators are calculated based only on working less than a threshold related to working time, i.e., below the cut-off point for a fully employed worker. Accordingly, the number of underemployed can be calculated by:

$$UE = \sum_{h=1}^{c} (WK)_h \tag{1}$$

where *UE* is underemployed, *WK* is the number of workers, and *h* is the number of working hours, which are calculated from 1 to the cut-off point (*c*) hour. All workers with zero working hours are excluded from the calculation.

Since there is no universal definition on the minimum number of hours in a week that would constitute full-time work, ILO has attempted to use a 30-hour per week cut-off point in as many

countries as possible in its Part Time Worker indicator. Unfortunately, there is also no clear explanation on why 30 hours per week was chosen (see the ILO *Manual on Key Indicators of the Labor Market*, in which underemployment is number 5 in the total 20 indicators).[6]

The actual cut-off points used across countries vary, ranging from 25 to 40 hours per week with 5-hour intervals as the most common one. In Indonesia, for instance, BPS uses 35 hours per week as the cut-off point for full-time workers but there is also no explanation why the 35-hour workweek was chosen. The number could have been taken from the previously required weekly working hours for government employees.

This paper argues that the cut-off points used by both ILO and BPS of 30 and 35 hours per week might be too low, especially for developing countries with the unique characteristics of their workers and the nature of work they are involved in. Moreover, the cut-off point should theoretically be determined in such a way that it can significantly differentiate the two groups of underemployed and fully employed with regard to some important characteristics relevant to both groups.

III. METHODOLOGY AND DATA USED

A. Determining the Cut-off Point Using Cluster Analysis

Cluster analysis is employed to determine the cut-off point of working hours, which is then used as the base for grouping workers into fully employed and underemployed. In doing so, the clustering method groups the workers into two significantly different groups, and based on the actual average working hours of each group, the cut-off point that differentiates the two groups is determined. This procedure is completely different from the common practice of calculating underemployment by using a cut-off point such as 30 hours (ILO) or 35 hours (BPS) per week, and then calculating the number of underemployed workers based on the cut-off point used.

The cluster analysis encompasses a number of different algorithms and methods for grouping similar objects into respective categories. It is an exploratory data analysis to sort different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal for otherwise. This technique has been applied to a wide variety of research problems. Hartigan (1975) provides an excellent summary of the many published studies reporting the results of cluster analyses. The method is useful to answer a general question on how to organize observed data into meaningful structures, i.e., to develop taxonomies. In general, cluster analysis is very useful in classifying piles of information into manageable, meaningful groups.

The objects of groupings may be cases or variables. Cluster analysis is a good technique of exploratory data analysis when the data set is not homogeneous (or heterogeneous) with respect to the cases or variables concerned. A cluster analysis of cases resembles a discriminant analysis, i.e., classifying a set of objects into groups or categories in which neither the number nor the members of the groups are known. On the other hand, a cluster analysis of variables is similar to factor analysis because both procedures identify related groups of variables.[7]

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[6] Altogether, the ILO *Manual on Key Indicators of the Labor Market* consists of seven major dimensions of a labor market, including indicators on labor force, employment, unemployment and underemployment, educational attainment, wages and compensation costs, labor productivity and labor costs, poverty and income distribution (ILO 2007).

[7] However, factor analysis has an underlying theoretical model, while cluster analysis is more ad hoc.

There are two methods for clustering objects into categories: the hierarchical cluster analysis and the K-means cluster analysis. The former clusters either cases or variables, while the latter clusters cases only. In hierarchical clustering, clustering begins by finding the closest pair of objects (cases or variables) based on a measurement for distance, then combining them to form a cluster. The algorithm continues one step at a time, joining pairs of objects, pairs of clusters, or an object with a cluster, until all the data are in one cluster. The clustering steps in this approach can be displayed in a tree plot or dendrogram. This method is hierarchical because once two objects or clusters are joined, they remain together until the final step. Therefore, a cluster formed in a later stage contains clusters from an earlier stage, which contains clusters from a still earlier stage.

K-means cluster analysis, on the other hand, starts clustering by using the values of the first k cases in the data file as temporary estimates of the cluster means, where k is the number of clusters specified.[8] Initial cluster centers are formed by assigning each case to the cluster with the closest center and then updating the center. An iterative process is then used to find the final cluster centers. At each step, cases are grouped into the cluster with the closest center, and the cluster centers are recomputed. This process continues until no further changes occur in the centers or until the maximum number of iterations is reached. We can also specify cluster centers and the cases will be automatically allocated to the selected centers. This will allow clustering new cases based on earlier results. The k-means cluster analysis procedure is especially useful for a large number of cases (i.e., more than 200 cases). The k-means method will produce exactly k different clusters of greatest possible distinction.

Computationally, clustering technique can also be thought as an analysis of variance (ANOVA) but in reverse order. The clustering starts with k random clusters, and then moving objects between those clusters with the goal to (i) minimize variability within clusters and (ii) maximize variability between clusters. In other words, the similarity rules will apply maximally to the members of one cluster and minimally to members belonging to the rest of the clusters.[9]

B. Assessing Clustering Results Using ANOVA Tests

The robustness of clustering results is then examined by assessing the resulting groups' differences with regard to independent and relevant variables that can be attributed to both underemployed and fully employed groups. More specifically, this means that the results of grouping the workers into two groups of fully employed and underemployed workers by using the ILO, BPS, and proposed cut-off points are assessed by comparing each group with regard to the particular variables concerned. There are 10 variables used in the assessment that consist of general and work-related variables. The general variables are sociodemographic variables such as gender, urbanity, age group, and education attainment, while the work-related variables are something to do with the workers' economic activities such as looking for a job, types of job looked for, main reason for

[8] The k-means algorithm was popularized and refined by Hartigan (1975). The basic operation of that algorithm is that given a fixed number of (desired or hypothesized) k clusters, observations are assigned to those clusters so that the means across clusters (for all variables) are as different from each other as possible (see also Hartigan and Wong 1978).

[9] This is analogous to "ANOVA in reverse" in the sense that the significance test in ANOVA evaluates between-group variability against within-group variability when computing the significance test for the hypothesis that the means in the groups are different from each other. In k-means clustering, the program tries to move objects (e.g., cases) in and out of groups (clusters) to get the most significant ANOVA results.

looking for a job, main reason for not looking for a job, willingness to accept a new job offered, having an additional job, and formality of the job.

The result assessment is essentially a one-way ANOVA, i.e., to examine whether or not the two groups are statistically different from each other with respect to the mean of the particular variables selected. The initial hypothesis (*Ho*) of this kind of testing is that there is no difference between the two groups' means with regard to the variables concerned, against the alternative hypothesis (*Ha*), that the means are significantly different. The main purpose of the study is to ensure that the two groups are statistically different.

It then follows that a higher value of observed statistics of F and χ^2 (chi-squared) is better since it indicates a better chance to reject the initial hypothesis. In this context, one can also observe the p-value of the test that shows the observed significance level. As a rule of thumb, a probability value of less then 5% shows that the groupings are justifiable for they are statistically different at 95% confidence interval. Furthermore, in the case where different cut-off points used for calculating the underemployed and fully employed workers can differentiate the two groups very well, which is also reflected in the low p-value, the observed values of χ^2 and F-statistics are used as the basis to determine which cut-off point is the best one. Since it is basically a one-sided statistical test, it then follows that the higher the observed values of χ^2 and F-statistics, the better the cut-off point in differentiating the characteristic of the two groups, i.e., fully employed and underemployed. Therefore, the values of χ^2 and F-statistics are used as the based for determining the best cut-off point.

C. Data Used

The data used in this study are mainly from the Indonesian Labor Force Survey, known in the Indonesian language as SAKERNAS (Survey Angkatan Kerja Nasional), revised version for 2003. SAKERNAS has been conducted in Indonesia by BPS since 1976. The number of households covered in the survey annually varies from 50,000–95,000 households. The main variables collected in the survey include gender, relation to head of household, educational attainment, main activity status during previous week, working at least one hour, temporarily not working, work experience, number of work day and work hours of all jobs, occupation of the main job, industrial classification of the main job, employment status of the main job, hours of work in the main job, workdays of the main job, average wages/salaries, seeking work, availability for work, kinds of action taken in seeking work, length of time in seeking work, type of job sought (part-time or full-time), and having additional jobs.[10]

IV. MAIN RESULTS

A. Average Working Hours

The descriptive statistics of working hours calculated from SAKERNAS 2003 show that the average working hours of workers in Indonesia was relatively high, at 39 hours per week, with a standard deviation of 14 hours. The working hours of workers in urban areas are longer and more

[10] For more information about the survey including some of its main results, see the BPS website at http://www.bps.go.id/sector/employ/index.html.

varied. Statistics in Table 1 show that the working hour is not normally distributed, as can be seen from the higher value of the kurtosis. In fact, the distribution of working hours is skewed to the right as can be seen from the positive value of the skewness indicator. This means that there are relatively more workers working below the average working hours than otherwise.

Table 1
Summary Statistics of Working Hours

Working Hours per Week	Urban	Rural	Total
Average	44	37	39
Standard deviation	14.5	13.7	14.4
Skewness	0.2	0.3	0.3
Kurtosis	3.8	3.3	3.5

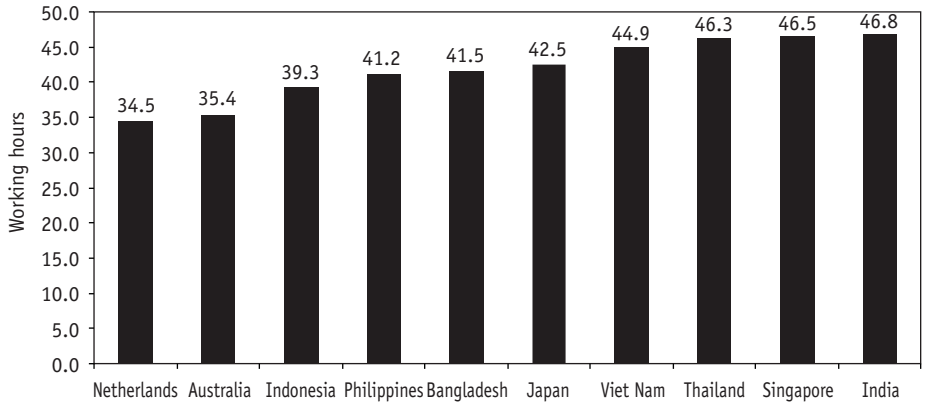
Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

Compared to other countries in Asia, the average working hour of workers in Indonesia is not the highest. An ILO study provides clear evidence that workers in Asia mostly work more hours than their counterparts in the other parts of the world (ILO 2005). In general, workers in developing countries usually work more hours due to various reasons such as the still important role of agriculture and informal sectors in the economy. The relatively high number of average working hours in developing countries can also be attributed to the significant number of low-paying jobs that make workers work much longer hours to meet their needs. This raises an issue of multiple job holders, which is also prevalent in developing countries.

Figure 4 shows the weekly average working hours of workers in 10 selected countries on which data is available. The figure clearly shows that Asian workers mostly work for longer hours than workers in the Netherlands and Australia. The average working hours in the selected Asian countries included in the data set range from 39 (in Indonesia) to 47 (in India) hours per week, while the working hour averages in the Netherlands and Australia are about the same at 35 hours per week. The graph also shows that the average working hours in all 10 selected countries are already more than 30 hours per week. Accordingly, the ILO 30-hour per week cut-off point for underemployment is significantly below the averages. This fact further strengthens the argument in this paper that the ILO cut-off point is too low to measure underemployment.

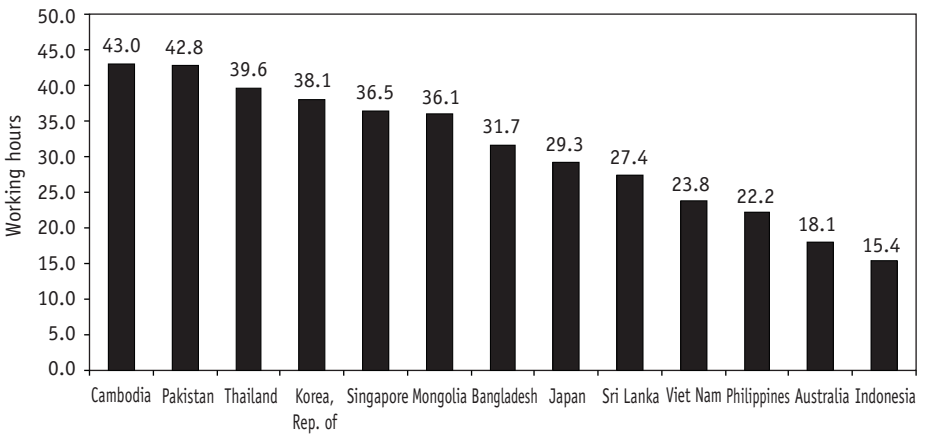
The evidence that workers in Asia mostly work for long hours can also be seen in the percentage of workers working for more than 50 hours per week. Figure 5 shows the percentage of employees working for more than 50 hours per week in 13 selected countries. As can be seen from the figure, these workers with long working hours constitute about 15% of workers in Indonesia and 43% of workers in Cambodia.

Figure 4
Average Working Hours per Week, 1995–2003



Source: Calculated from *Labor and Social Trends in Asia and the Pacific* (ILO 2005).

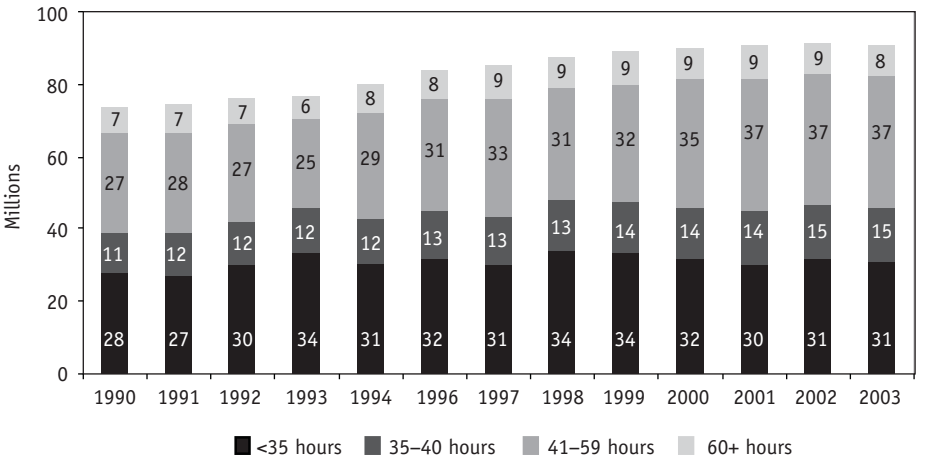
Figure 5
Percentage of Employed Working 50 Hours or More a Week



Note: For the latest year available.
Source: *Labor and Social Trends in Asia and the Pacific* (ILO 2005).

Moreover, there are also some workers excessively working for very long hours. Sugiyarto et al. (2006) show that about 8 million workers in Indonesia actually work for more than 60 hours per week. Figure 6 clearly indicates that during 1990–2003, there were about 6–9 million workers in this category. This case, unfortunately, is not unique to Indonesia for many of those working for more than 50 hours per week in other selected countries depicted in Figure 5 are actually working for more than 60 hours per week.

Figure 6
Number of Workers in Indonesia by Their Working Hours



Source: Sugiyarto et al. (2006).

B. Determining the Cut-off Point

Before conducting cluster analysis to group workers into underemployed and fully employed, data exploration using determinant analysis was conducted. The main purpose was to determine which variable should be used as the base for the clustering analysis. The results reveal that total wage is the most significant determinant variable of the number of hours worked by the employed group. Therefore, the total wage variable is used as the basis for clustering the workers. Furthermore, as was discussed in the methodology section, the K-means clustering analysis is used to group the workers into two statistically different categories. Based on the grouping results, the average working hours in each group is calculated and the cut-off point for working full time can be determined.

The k-clustering results produce two groups of workers. The first group has an average working hour of around 44 hours per week while the second group has an average working hour of about 37 hours per week. Taking these two averages into account, the cut-off point for underemployment is therefore 40 hours per week. Table 2 summarizes this result.

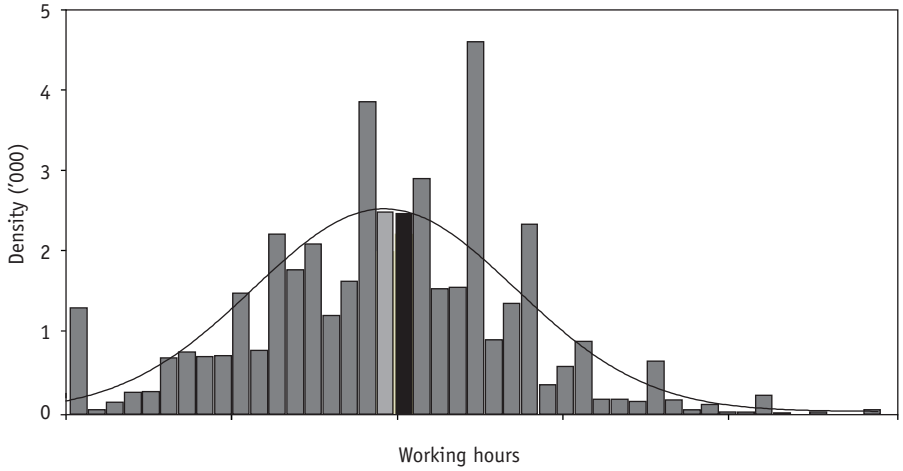
Table 2
Average Working Hours of Each Group and the Cut-off Point for Underemployment

	Group 1	Group 2	Cut-off Point
Working hours per week	44	37	40

Source: Author's calculations using the K-means clustering method on SAKERNAS 2003 (BPS 2003).

Notice that the resulting cut-off point from the clustering analysis is significantly higher than the ILO and BPS cut-off points of 30 and 35 hours per week. The cut-off point is also slightly higher than the average working hour for all Indonesian workers, which is 39 hours per week. For discussion purposes, the new cut-off point of 40 hours per week henceforth is named as the ADB cut-off point.

Figure 7
Average Working Hour and Cut-off Point for Underemployment in Distribution of Workers by Number of Working Hours



Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

Figure 7 shows the number of workers for different working hours per week with the overlying normal graph. The graph confirms the summary statistics presented in Table 1 that the distribution of workers according to their working hours is not normal but skewed to the right[11] (i.e., positive skewness) as there are relatively more workers working less than the average working hours than otherwise. The figure also shows that there are some outliers on number of workers for certain working hours, which might be due to characteristics of the job such as sector, types, and status. These, however, are not further explored in this paper.

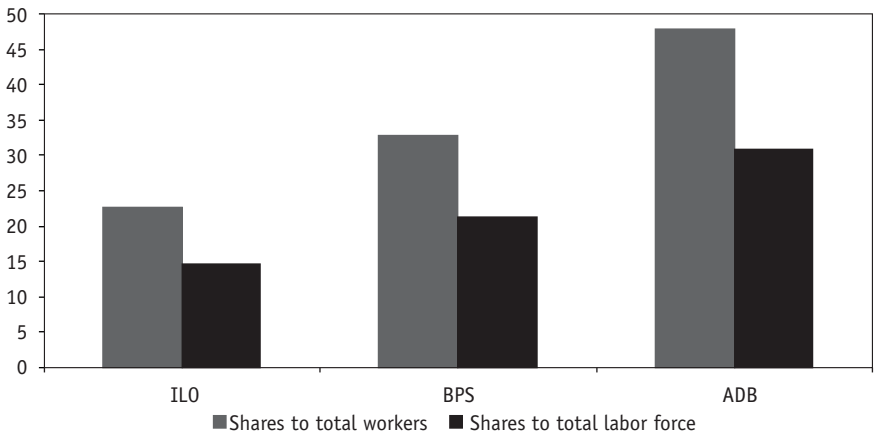
C. Measuring Underemployment

Once the cut-off point for working full-time is determined, underemployment can be estimated by calculating the number of workers who are working less than the cut-off point. Those who are working above the cut-off point are classified as fully employed workers. For developing the underemployment indicators, the number of underemployed is divided by the number of total workers to represent the underemployment share or, alternatively, by the number of the total labor force to represent the underemployment rate.

[11] This is a statistical term meaning that the data distribution is skewed to the right of the graph, and not to the right hand side of the reader.

Applying the ILO and BPS cut-off points on the revised SAKERNAS 2003 data results in underemployment shares of 23% and 33% of the total workers, whereas according to the ADB cut-off point, the underemployment share should be around 48%. In terms of underemployment rates, their corresponding rates based on the three cut-off points would be 15%, 21%, and 31% of the total labor force, respectively. Figure 8 compares these results, which show that the ADB cut-off point produces the highest underemployment share and underemployment rate.

Figure 8
Underemployment Shares and Underemployment Rates Calculated Using ILO, BPS, and ADB Cut-off Points



Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

As can be seen from the results, the difference in the underemployment shares and underemployment rates using the three cut-off points is really significant and cannot just be ignored. In term of underemployment share, the difference between the ILO and ADB results is more than 25 percentage points, while the difference between the BPS and ADB results is about 15 percentage points. In term of rates, their differences would be 16 percentage points between the ILO and ADB results, and 10 percentage points between the BPS and ADB results.

To put these in perspective, one percentage point in the workforce equals 0.93 million workers while one percentage point in the labor force constitutes about 1.03 million of the labor force. The total number of workers and labor force based on SAKERNAS 2003 are about 92.8 million workers and 102.6 million of the labor force, respectively (ADB 2006). Therefore, the difference between the ILO and ADB results will be about 23.2 million workers, a staggering number even by Indonesian standards. By ILO definitions, these workers will be classified as fully employed, while the ADB measure classifies them as underemployed. The estimated number of underemployed by ILO standard is 21.3 million workers, while according to the ADB cut-off point the number would be 44.5 million[12] workers.

Notice that the consequences of changes in the cut-off points from 30 to 35 and then from 35 to 40 hours per week on the underemployment figures have become more considerable. In moving from

[12] This number is slightly different with the number of workers working less than 40 hours per week in Figure 6, which is around 46 million workers. The main reason is because the calculation of the number of workers during 1990–2003 for 2003 is based on the unrevised SAKERNAS 2003, while this study is based on the revised (latest) version of SAKERNAS 2003.

30 to 35 hours per week, a 1-hour increase in the cut-off point will increase about 2.5 percentage points the underemployment share, while the same 1-hour increase in moving from 35 to 40 hours per week results in a higher increase of 3 percentage points in the underemployment share. In term of rates, the increases are from 1.6 to 2 percentage points, respectively. Therefore, a 1-hour increase in the cut-off point results in an increase of 3 percentage points in the underemployment share and 2 percentage points in the underemployment rate. Table 3 summarizes the underemployment and full employment shares and rates calculated using the three different cut-off points.

SAKERNAS also collects information about worker economic activities such as looking for a job, having an additional job, and accepting a new job offered. Table 4 summarizes the average working hours of workers with these additional economic activities. It seems that looking for a job for a worker is a good indication of underutilization, especially with regard to the hours that the workers would like to work and actually work. This shows that the average working hours of those who are looking for a job is lower than the ones not looking for a job. The average working hour of workers still looking for a job is about 37.5 hours per week, lower than the average of those not looking for job, which is around 39 hours per week. A similar pattern can be observed with workers who have an additional job, whether or not they are looking for a job.

From Table 4, one can calculate the massive scale of the underemployment volume represented by the number of hours needed to make all underemployed workers fully employed. The average working hours of underemployed by ADB standards, i.e., those who are working less than 40 hours per week, is only 28 hours per week. As their share in the workforce is 48% (Figure 8), this means that 48% of the existing workers need to work for at least 12 hours more per week to become fully employed. Therefore, in terms of working hours, the underemployment volume in Indonesia is about 534.5 million working hours, which is calculated by multiplying the number of underemployed with the average shortfall share (48% x 92.8 million x 12 hours). Using 40 hours per week as the cut-off point for a full-time worker, the underemployment volume of 534.5 million working hours will be equivalent to 13.4 million full-time jobs.

Table 3
Underemployment by Different Cut-off Points

Cut-off Points	Classification	Shares to Total Workers	Shares to Total Labor Force
ILO	Underemployed	22.6	14.6
	Fully employed	77.4	50.0
BPS	Underemployed	32.8	21.2
	Fully employed	67.2	43.4
ADB	Underemployed	47.8	30.9
	Fully employed	52.2	33.7

Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

Table 4
Average Working Hours per Week of Different Types of Workers (hours)

Cut-off points	Classification	Average Working Hours of				
		Workers	Workers Looking for a Job	Workers with an Additional Job	Workers with Additional Job and Looking for a Job	Workers with Additional Job, Not Looking but Accepting New Job Offered
ILO	Underemployed	20.9	20.3	23.0	21.8	23.1
	Fully employed	45.4	44.8	46.2	45.1	46.0
BPS	Underemployed	24.2	23.4	27.1	25.8	27.0
	Fully employed	47.5	47.1	47.8	47.0	47.7
ADB	Underemployed	28.0	26.6	31.2	29.6	31.4
	Fully employed	50.7	50.1	50.4	49.7	50.6
Overall		39.3	37.5	43.6	41.3	43.4

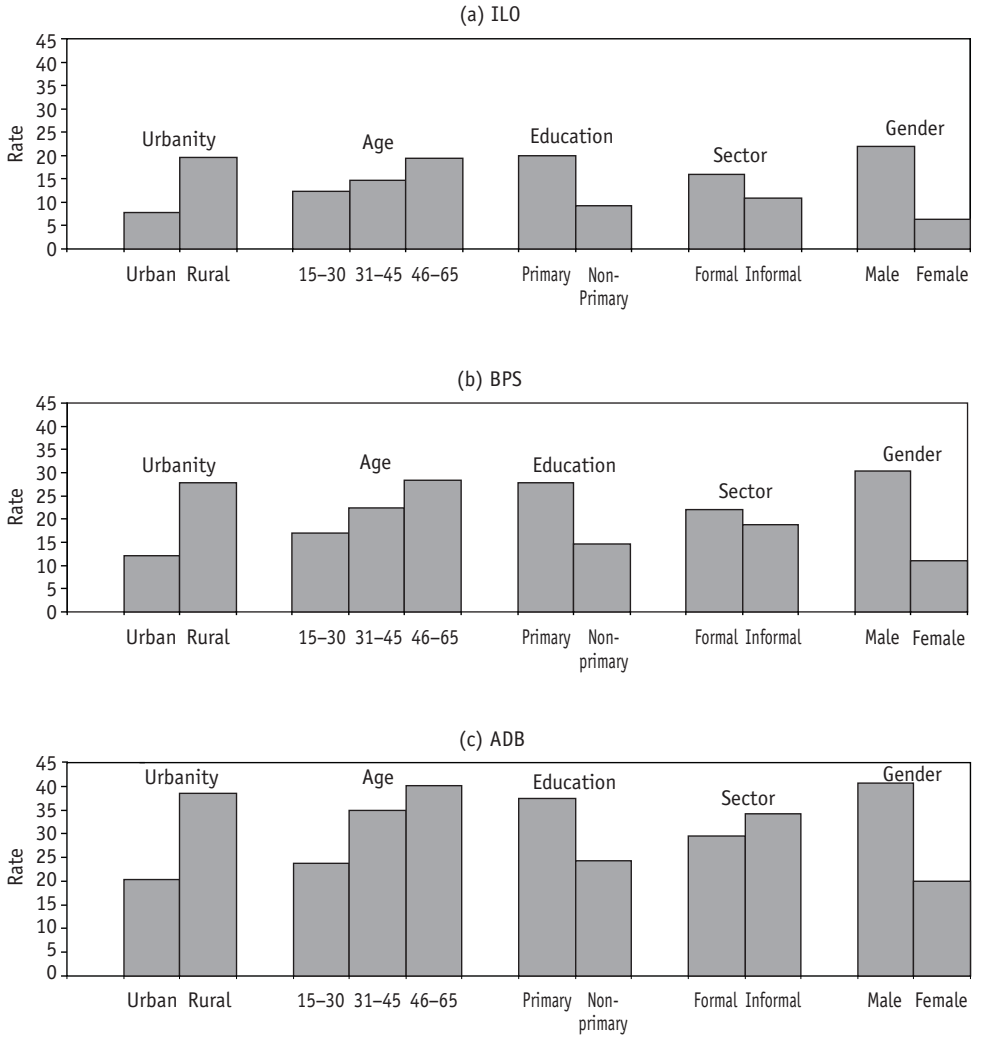
Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

D. Characteristics of the Underemployed

Figure 9 panels (a) to (c) show the underemployment rates among the workers by general socio-economic-demographic variables such as age, education attainment, sector, gender, and urban/rural, calculated using the three different cut-off points of ILO, BPS, and ADB. The figures show that the underemployment rate is relatively more prevalent among males, old-age (45-65), low-educated, informal workers, and rural areas. This pattern is consistent across the three different cut-off points, even though the magnitudes of the difference among the three are not the same.

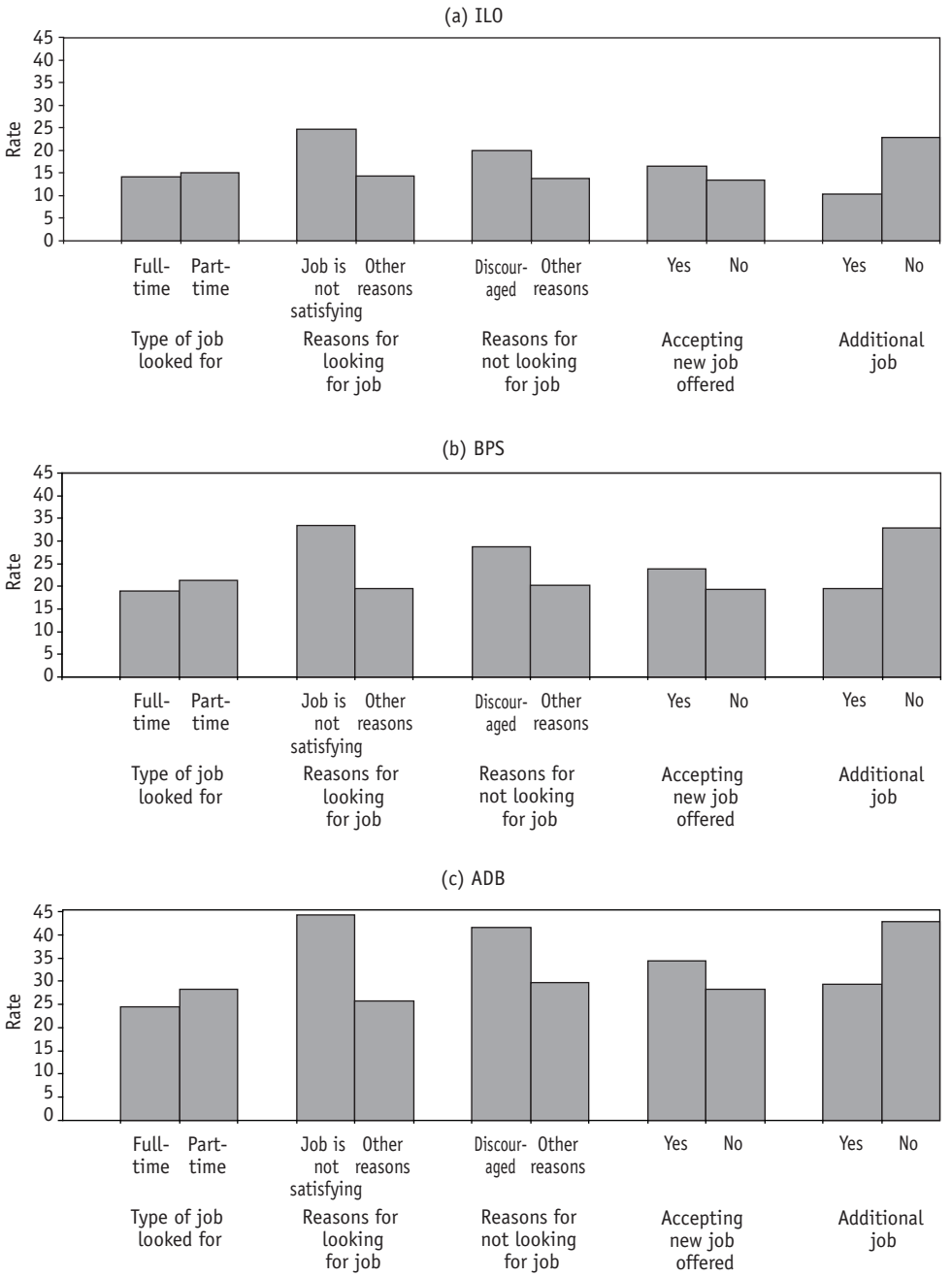
Comparing the underemployment rates across different cut-off points and for work-related variables such as reason for looking or not looking for a job, type of job looked for, accepting new job offered, and having additional job, a similar pattern can also be seen in Figure 10 panels (a) to (c). The overall results show that most underemployed have no additional job and they are not satisfied with their existing job. For those looking for a job, they are mostly looking for part-time jobs, while those who are not looking for a job still accept any new job offered. The main reason for not looking for a job is the feeling of impossibility to get the job or discouragement.

Figure 9
Underemployment Rates Among Different Groups of Workers Based on Different Cut-off Points and General Variables (percent)



Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

Figure 10
Underemployment Rates Among Different Groups of Workers Based on Different Cut-off Points and Work-related Variables (percent)



Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

The general socioeconomic characteristics of the fully employed group are completely the opposite of the underemployed (Tables 5 and 6). Most fully employed workers are female, work in urban areas, aged 31–45 years old, have more education, and work in the formal sector. On the other hand, the characteristics of the fully employed workers are not different from the underemployed especially with regard to the work-related variables. The only exception is the criterion having an additional job, which was prevalent among the fully employed workers. For the remaining variables, the fully employed group is also not satisfied with their existing job; for those who are looking for a job, they are mostly looking for a part-time job; while those not looking are still accepting new jobs offered. Again, the main reason for not looking for a job is the feeling of impossibility to get a job or discouragement.

The overall picture suggests a poor working condition for workers in Indonesia. Despite their relatively long working hours, most of them are still not happy with their jobs, making them look for other jobs. Those who are not looking for a job are the discouraged workers, who realize that they will not get any.

Table 5
Underemployment and Full Employment Rates (percent)

General Variables	ILO		BPS		ADB	
	Underemployed	Fully Employed	Underemployed	Fully Employed	Underemployed	Fully Employed
Urbanity						
Urban	7.8	50.4	12.1	46.1	20.3	37.9
Rural	19.6	49.7	27.8	41.4	38.5	30.7
Age						
15–30	12.4	38.5	17.0	33.9	23.7	27.2
31–45	14.6	63.5	22.5	55.7	34.9	43.3
46–65	19.5	53.5	28.5	44.5	40.2	32.8
Education						
Primary	19.9	49.0	27.7	41.2	37.5	31.5
Nonprimary	9.3	50.9	14.7	45.5	24.2	36.0
Sector						
Informal	16.0	35.3	22.1	29.2	29.6	21.8
Formal	10.9	88.0	18.8	80.1	34.2	64.7
Gender						
Male	22.0	48.5	30.4	40.1	40.6	29.9
Female	6.4	51.6	11.0	47.0	20.0	38.0
Total	14.6	50.0	21.2	43.4	30.9	33.7

Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

Table 6
Underemployment and full employment rates (percent)

Work-related Variables	ILO		BPS		ADB	
	Underemployed	Fully Employed	Underemployed	Fully Employed	Underemployed	Fully Employed
Type of job looked for						
Full-time	14.2	33.3	18.9	28.5	24.5	22.9
Part-time	15.1	36.2	21.3	30.0	28.3	22.9
Reasons for looking for a job						
Job is not satisfying	24.7	76.8	33.5	68.0	44.3	57.2
Other reasons	14.3	32.7	19.6	27.5	25.7	21.4
Reasons for not looking for a job						
Impossible to get (discouraged)	20.0	61.6	28.8	52.9	41.6	40.1
Other reasons	13.8	49.4	20.2	43.0	29.6	33.6
Acceptance of new job offered						
Yes	16.6	60.0	23.9	52.7	34.3	42.3
No	13.4	42.9	19.3	37.0	28.3	28.0
Presence of additional jobs						
Yes	10.4	89.6	19.5	80.5	29.3	70.7
No	22.9	74.1	32.9	64.0	42.9	54.0

Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

E. ANOVA Tests for Assessing the Classification Results

As discussed in the methodology section, the robustness of the results of classifying workers into fully employed and underemployed using the three different cut-off points of ILO, BPS, and ADB are assessed using ANOVA tests. In doing so, some independent variables are used as a base for the test. The variables can be classified into two categories, namely sociodemographic variables such as gender, urbanity, education, and age; as well as variables related to work or economic activities such as formality of the existing job, having additional jobs, reasons for looking for jobs, types of jobs looked for, reasons for not looking for jobs, and willingness to accept a new job offered to those who are not looking for jobs. Therefore, there are altogether 10 variables used in the assessment.

Table 7 summarizes the test results of associations between fully employed and underemployed workers based on the three cut-off points with the 10 variables used in the assessment, complete with the statistics of χ^2, and F-test.

Table 7
ANOVA Tests of Fully and Underemployed Workers with Respect to Some Selected Variables

		ILO			BPS			ADB		
		<30 hrs	>=30 hrs	Total	<35 hrs	>=35 hrs	Total	<40 hrs	>=40 hrs	Total
Urbanity										
Urban		1,755	11,386	13,141	2,738	10,403	13,141	4,582	8,559	13,141
Rural		6,090	15,462	21,552	8,655	12,897	21,552	11,990	9,562	21,552
Total		7,845	26,848	34,693	11,393	23,300	34,693	16,572	18,121	34,693
	Chi-square		1,000.0			1,411.0			1,438.0	
	F-value		1,067.8			1,439.3			1,470.5	
Age										
15-30		3,050	9,494	12,544	4,189	8,355	12,544	5,839	6,705	12,544
31-45		2,616	11,371	13,987	4,022	9,965	13,987	6,242	7,745	13,987
46-65		2,179	5,983	8,162	3,182	4,980	8,162	4,491	3,671	8,162
Total		7,845	26,848	34,693	11,393	23,300	34,693	16,572	18,121	34,693
	Chi-square		220.7			247.3			249.0	
	F-value		4.1			42.0			110.8	
Education										
Primary		5,338	13,126	18,464	7,426	11,038	18,464	10,038	8,426	18,464
Non-primary		2,507	13,722	16,229	3,967	12,262	16,229	6,534	9,695	16,229
Total		7,845	26,848	34,693	11,393	23,300	34,693	16,572	18,121	34,693
	Chi-square		894.6			974.5			688.6	
	F-value		918.2			1,002.7			702.6	
Sector										
Informal		6,208	13,675	19,883	8,575	11,308	19,883	11,453	8,430	19,883
Formal		1,637	13,173	14,810	2,818	11,992	14,810	5,119	9,691	14,810
Total		7,845	26,848	34,693	11,393	23,300	34,693	16,572	18,121	34,693
	Chi-square		2,000.0			2,200.0			1,800.0	
	F-value		2,092.0			2,388.9			1,904.5	
Gender										
Male		3,305	18,893	22,198	5,401	16,797	22,198	8,692	13,506	22,198
Female		4,540	7,955	12,495	5,992	6,503	12,495	7,880	4,615	12,495
Total		7,845	26,848	34,693	11,393	23,300	34,693	16,572	18,121	34,693
	Chi-square		2,100.0			2,000.0			1,800.0	
	F-value		2,236.6			2,148.2			1,933.6	

(*continued*)

Table 7. continued.

	ILO			BPS			ADB		
	<30 hrs	>=30 hrs	Total	<35 hrs	>=35 hrs	Total	<40 hrs	>=40 hrs	Total
Full-time	268	628	896	357	539	896	463	433	896
Part-time	187	450	637	264	373	637	352	285	637
Total	455	1,078	1,533	621	912	1,533	815	718	1,533
Chi-square		0.1			0.4			1.9	
F-value		0.1			0.4			1.9	
Reasons in looking for job									
Job is not satisfying	48	149	197	65	132	197	86	111	197
Other reasons	407	929	1,336	556	780	1,336	729	607	1,336
Total	455	1078	1,533	621	912	1,533	815	718	1,533
Chi-square		4.1			5.7			8.3	
F-value		4.2			5.7			8.3	
Reasons for not looking for job									
Impossible to get (discouraged)	1,287	3,958	5,245	1,848	3,397	5,245	2,672	2,573	5,245
Other reasons	6,103	21,812	27,915	8,924	18,991	27,915	13,085	14,830	27,915
Total	7,390	25,770	33,160	10,772	22,388	33,160	15,757	17,403	33,160
Chi-square		13.1			16.1			25.0	
F-value		13.1			16.1			25.0	
Accepting new job offered									
Yes	2,854	10,334	13,188	4,121	9,067	13,188	5,909	7,279	13,188
No	3,913	12,563	16,476	5,655	10,821	16,476	8,286	8,190	16,476
Total	6,767	22,897	29,664	9,776	19,888	29,664	14,195	15,469	29,664
Chi-square		18.5			31.3			88.3	
F-value		18.5			31.4			88.6	
Additional job									
Yes	274	2,357	2,631	513	2,118	2,631	772	1,859	2,631
No	7,571	24,491	32,062	10,880	21,182	32,062	14,197	17,865	32,062
Total	7,845	26,848	34,693	11,393	23,300	34,693	14,969	19,724	34,693
Chi-square		242.1			229.7			202.8	
F-value		243.8			231.3			204.0	

Source: Author's calculations based on SAKERNAS 2003 (BPS 2003).

The overall results suggest that all three cut-off points can differentiate very well full employment from underemployment as can be seen from their statistically significant statistics of χ^2 and F. In fact, the *p*-values of all the tests are already zero, which is why they are excluded from the summary table. In other words, all initial hypotheses that there is no difference in the characteristics between fully employed and underemployed workers with respect to the 10 variables concerned are all rejected. This means that the characteristics of underemployed and fully employed workers are significantly different.

Moreover, comparing the χ^2 and F-statistics across different cut-off points shows that the results of applying the BPS cut-off point are better than those of ILO, and that the results of applying the ADB cut-off point are superior to those of BPS and ILO. The summary table shows that ADB

cut-off point results perform best in the 6 out of 10 variables used in the assessment. This best performance is indicated by the highest values of the χ^2 and F-statistics. The only exception is on the results on the variables gender, education, having an additional job, and formality of the job. In the gender and having additional job variables, the ILO cut-off point performs better than ADB while in the other two variables the BPS cut-off point results are the best.

V. CHOW TEST AND RECURSIVE DYNAMIC REGRESSION ANALYSIS

Another way to determine and/or assess the cut-off point is by using econometric methods. This is conducted first by establishing the economic relationship between working hours and some determinant variables, and then conducting regression analysis for different subsamples of workers based on their working hours. The main purpose is to find out the best cut-off point of working hours such that the workers can be best divided into two groups of fully employed and underemployed.

In general, the empirical model of working hours can take the form:

$$WH_i = f(DV_i, CV_i, D_i) \quad (2)$$

where *WH* is the working hours, *DV* is the determinant variable, *CV* is the control variable, and D is the dummy variable that takes into account variations in factors excluded in the model. The dummy variable can take the form of additive and multiplicative dummy variables, depending on the data distribution and estimation results. For exploratory purposes and to further strengthen the case in finding the best cut-off point, the regression model is estimated in both cases of bivariate and multiple variable models. The results indicate that the best bivariate model is in the form of:

*Working hours = cons + b1*wage_tot + b2*group_ue + b3*group_ue*wage_tot + e*

Meanwhile, the best multiple regression model is as follows:

*Working hours = cons + b1*wage_tot + b2*look_job + b3*add_job + b4*urb + b5*sex + b6*group_ue + e*

where:

wage_tot = total wages both cash and kind; *look_job* = looking for job dummy; *add_job* = additional job dummy, *urb* = urban/rural dummy; *sex* = male/female dummy; and *group_ue* = underemployed group defined by working less than 25–45 hours per week.

Based on the best empirical model that can be developed from the data sets, two methods for assessing and/or determining the cut-off point can be used. These methods are the Chow test and the recursive dynamic regression technique.

A. Chow Test

The Chow test is commonly used to examine the parameter instability of a model across the whole sample. The main question here is whether the relationship depicted in the model holds over the whole sample. To answer the question, the sample is divided into two groups and the model is then run on the subsamples and total sample to see if there is any change observed in

the parameter estimates. This is the underlying process of the Chow test. Formally, the hypothesis-testing problem can be summarized as follows:

Consider the linear model $Y = X\beta+\varepsilon$. As there are two sub samples, (1) and (2), in which the parameters are not necessarily the same, therefore:

$$Y_i = X_i\ \beta_1+\varepsilon_i \qquad i \in (1) \qquad (3)$$

$$Y_i = X_i\ \beta_2+\varepsilon_i \qquad i \in (2) \qquad (4)$$

The hypothesis-testing in this context is Ho : $\beta_1 = \beta_2$, and the total number of observations is $n = n1 + n2$.

The Chow test is actually an application of the F-test, since the regression's sum squared errors (RSS) from the three regressions for each subsample and for the total sample follow the *F* distribution. Under H_o

$$\frac{(RSS - RSS_J - RSS_2)/K}{(RSS_1 + RSS_2)/(n_1 + n_2 - 2k)} \Rightarrow F_{k,n_1+n_2-2k} \qquad (5)$$

The application of the Chow test in this study is to examine if the two groups of fully employed and underemployed workers have different characteristics with respect to some independent variables. The difference is reflected in the parameters of the variables concerned across the different groups.

Therefore based on the best bivariate and multiple regressions, a series of Chow tests is conducted by running the models on the total sample as well as on the subsamples, which were formed by dividing the total sample into two groups using different cut-off points of working hours. Accordingly, the level of working hours that corresponds to the highest level of parameter change detected by the Chow test should be used as the cut-off point for underemployment, for that implies that the two groups of workers have the most statistically significant difference in the regression parameters.

B. Recursive Regression Technique

The recursive regression technique is conducted by running a series of regressions recursively, i.e., starting from a certain subsample and then adding a new sample continuously. A record of the regression statistics is compiled to examine if there is any significant shift in the model's parameters.

The number of working hours on which the structural break is identified by the Chow test and/or recursive regression can then be used as a proxy for the cut-off point for fully employed and underemployed workers. Furthermore, assuming that the cut-off point of working hours would be in the range of 25–45 hours per week, the Chow test and recursive regression analysis are conducted only within this band of working hours. Therefore, a possibility that the cut-off point would be below 25 or above 45 hours per week is dropped in the analysis.

C. Test Results

Chow test results for the bivariate and multivariate models further confirm that 40 hours per week is a very good cut-off point for determining underemployment and full employment.

Tables 8 and 9 summarize the regression statistics conducted for the Chow tests. Figure 11 shows the regression result statistics of the recursive regressions, namely the F-statistics of both the bivariate and multiple regression models, and the adjusted R-squared. As can be seen from the summary tables, the 40 hours per week cut-off point produces the highest F-statistics in the Chow test in both bivariate and multiple regressions. This means that the 40 hours per week cut-off can differentiate the two groups of workers most strongly, as reflected in the highest change detected in the regression parameter. The 40 hours per week cut-off point also produces the highest F-statistic, R-squared, and adjusted R-squared in the regression estimates. All these indicate that the model with this subsample is the most powerful one in explaining the relationship captured by the model. Moreover, the lowest MSE of the 40 hours per week cut-off point further indicates that the regression with this subsample is also the most efficient. Therefore, the 40 hours per week cut-off point is indeed the best, compared to the cut off-points of 30 and 35 hours per week.

The recursive regression results of the bivariate and multivariate models also confirm that the 40 hours per week is the best cut-off point for determining underemployment and full employment (see Figure 12).

Table 8
Summary Chow Test Statistics of Bivariate Model

Working hours	F-stat	Prob>F	R-squared	Adj R-squared	Root MSE	F-Chow
25	11490.99	0.00	0.49	0.49	11.19	16665.14
26	12230.73	0.00	0.51	0.51	11.02	17756.69
27	12668.05	0.00	0.52	0.52	10.92	18401.99
28	13065.43	0.00	0.52	0.52	10.83	18988.35
29	14177.32	0.00	0.54	0.54	10.60	20629.02
30	14562.68	0.00	0.55	0.55	10.52	21197.66
31	15817.30	0.00	0.57	0.57	10.28	23048.94
32	16122.73	0.00	0.58	0.58	10.22	23499.62
33	16568.63	0.00	0.58	0.58	10.14	24157.58
34	16888.67	0.00	0.59	0.59	10.09	24629.82
35	17087.23	0.00	0.59	0.59	10.05	24922.82
36	17455.76	0.00	0.59	0.59	9.99	25466.61
37	17961.59	0.00	0.60	0.60	9.90	26213.00
38	18082.93	0.00	0.60	0.60	9.88	26392.04
39	18108.34	0.00	0.60	0.60	9.88	26429.54
40	18051.49	0.00	0.60	0.60	9.89	26345.65
41	17722.20	0.00	0.60	0.60	9.94	25859.76
42	17496.29	0.00	0.60	0.60	9.98	25526.41
43	16212.68	0.00	0.58	0.58	10.21	23632.35
44	16043.66	0.00	0.57	0.57	10.24	23382.95
45	15673.65	0.00	0.57	0.57	10.31	22836.97

Source: Author's calculation from SAKERNAS 2003 (BPS 2003).

Table 9
Summary Chow Test Statistics of Multivariate Model

Working Hours	F-stat	Prob>F	R-squared	Adj R-squared	Root MSE	F-Chow
25	3505.93	0.00	0.52	0.52	10.88	4868.12
26	3687.18	0.00	0.53	0.53	10.74	5158.55
27	3794.58	0.00	0.54	0.54	10.65	5330.64
28	3904.08	0.00	0.55	0.55	10.57	5506.10
29	4185.80	0.00	0.56	0.56	10.37	5957.51
30	4279.92	0.00	0.57	0.57	10.30	6108.31
31	4572.15	0.00	0.58	0.58	10.11	6576.56
32	4653.33	0.00	0.59	0.59	10.06	6706.64
33	4760.52	0.00	0.59	0.59	9.99	6878.39
34	4847.33	0.00	0.60	0.60	9.94	7017.48
35	4924.52	0.00	0.60	0.60	9.89	7141.18
36	5018.43	0.00	0.61	0.61	9.83	7291.65
37	5139.26	0.00	0.61	0.61	9.76	7485.25
38	5174.27	0.00	0.61	0.61	9.74	7541.36
39	5187.66	0.00	0.62	0.62	9.73	7562.80
40	5191.73	0.00	0.62	0.62	9.73	7569.33
41	5116.39	0.00	0.61	0.61	9.77	7448.62
42	5069.72	0.00	0.61	0.61	9.80	7373.83
43	4743.04	0.00	0.59	0.59	10.00	6850.39
44	4706.12	0.00	0.59	0.59	10.02	6791.22
45	4609.61	0.00	0.59	0.59	10.09	6636.58

Source: Author's calculation from SAKERNAS 2003 (BPS 2003).

Figure 11
Chow Test Results of Bivariate and Multivariate Regression Models

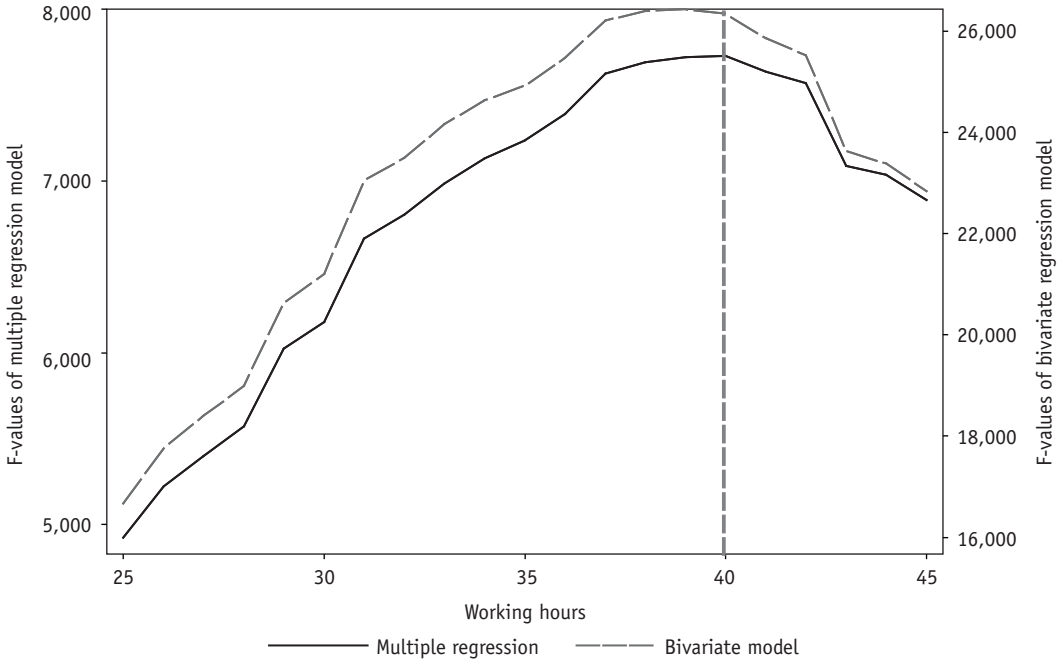
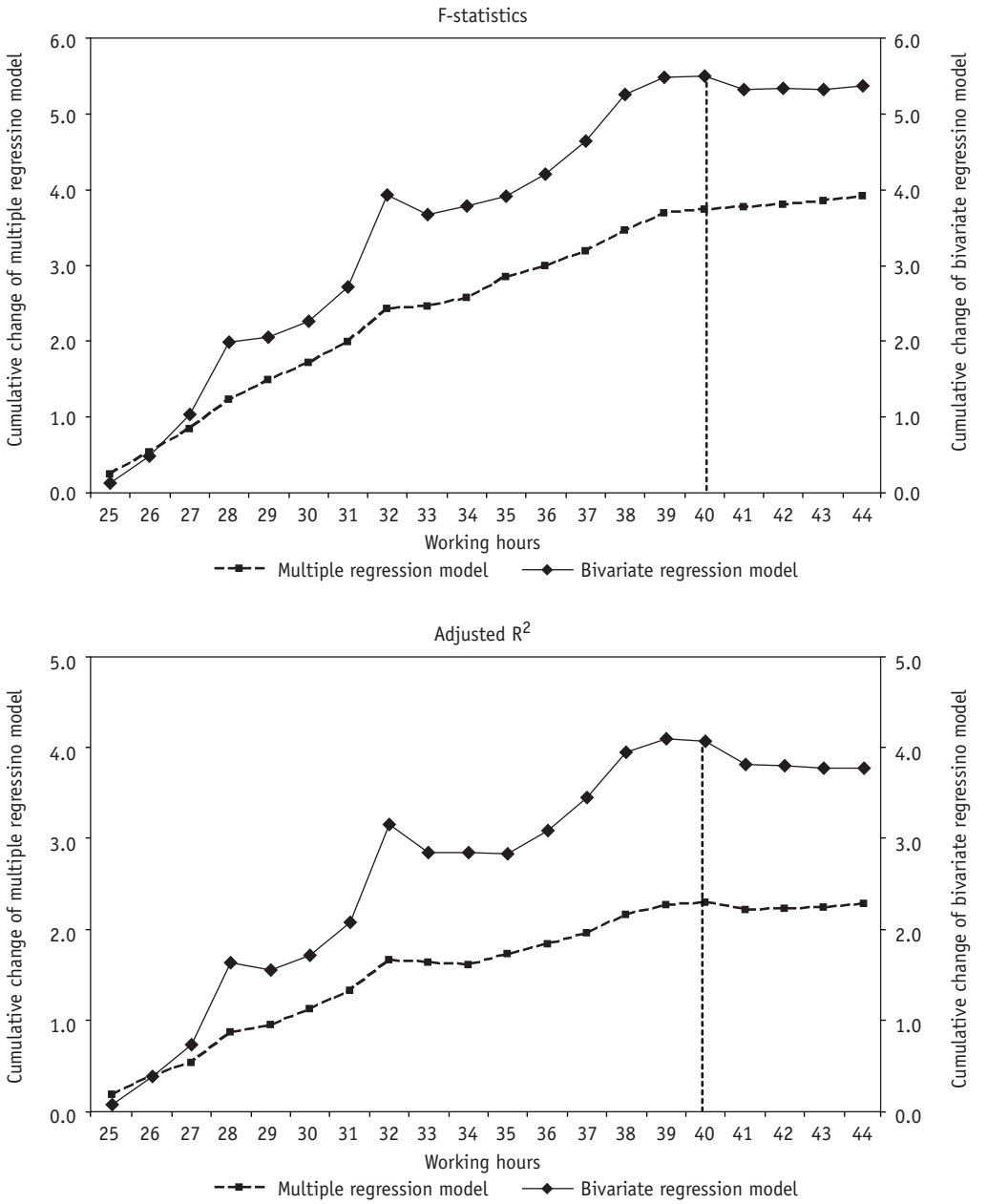


Figure 12
Recursive Regression Results of Bivariate and Multivariate Models



Source: Author's calculation from SAKERNAS 2003 (BPS 2003).

VI. CONCLUSION AND POLICY IMPLICATION

Unemployment and underemployment are the most pressing problems in Asia today as reflected by the widespread underutilization rate of about 29% of the total labor force. The underutilization rate could have been higher if a better measure were used in the calculation. The standard labor force framework currently in use worldwide is biased toward counting a labor force as employed rather than as unemployed against the backdrop that most of the labor force in developing countries cannot afford to be completely unemployed. This systematically undervalues the full extent of the unemployment problem, which makes the introduction of underemployment indicators necessary to complement the open unemployment indicator and to better measure underutilization.

The current underemployment measurement, however, also has conceptual and practical problems that systematically understate the underemployment level. The existing guidelines to measure time-related underemployment using the cut-off point for full-time work set the threshold too low, resulting in a considerable under representation of underemployment, which has serious policy implications.

This study shows the consequences of the measures used and suggests a better way to determine the cut-off point and therefore measure underemployment. The cluster method is adopted to determine the better cut-off point and the robustness of its application results are assessed using ANOVA tests. The Chow test and recursive dynamic regression are also employed to determine and/or assess the best cut-off point for measuring underemployment.

The consequence of using an incorrect cut-off point for underemployment is very significant since a small change in the cut-off point will result in a much bigger change in underemployment rate and incidence. In the Indonesian context, for instance, applying the ILO and BPS cut-off points of 30 and 35 hours of work per week will result in underemployment shares of 23% and 33%, respectively. Meanwhile, according to the ADB cut-off point of 40 hours per week, underemployment should be around 48% of the total workers. In term of underemployment rates, the numbers would be 15%, 21%, and 31% of the total labor force, respectively. Underemployment shares according to ILO and ADB results differ by more than 25 percentage points, while between ADB and BPS the difference is about 15 percentage points. In term of underemployment rates, their differences would be 16 and 10 percentage points, respectively.

Overall, a 1-hour increase in the cut-off point results in an increase of 3 percentage points in the underemployment share and 2 percentage points in the underemployment rate. During 1990–2003, there were about 11–15 million workers who were working between 35 and 40 hours per week in Indonesia (Sugiyarto et al. 2006). They could be misclassified as fully employed workers according to the BPS definition. This misclassification cannot just be ignored for it has serious policy implications on the effort to promote full, productive, and freely chosen employment. Moreover, the average working hours of the underemployed by the ADB standard in Indonesia is only 28 hours per week. Considering about 48% of workers are underemployed and the number of workers is about 92.8 million, the volume of underemployment in Indonesia is about 534.5 million working hours. This is equivalent to 13.4 million full-time jobs that must be generated just to make the underemployed fully employed.

Learning from the Indonesian and Philippine cases, the cut-off point seems better determined at the individual country level to consider country-specific characteristics. If a comparison across countries is needed, a 40 hours per week cut-off point is better than the currently used ILO standard

of 30 hours per week. The consequence of misclassifying the underemployed as fully employed is more serious than otherwise. Moreover, the more recent approach at the international level is the promotion of a 40-hour workweek as a standard to be realized by ILO member states, and that 40-hour workweek is now the most prevalent weekly hour standard (McCann 2005). The 40-hour workweek is also in line with the Forty-Hour Week Convention 1935 No. 47, and the reduction of hours of work recommendation 1962 No. 116.

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www.adb.org/economics
ISSN: 1655-5252
Publication Stock No. 030907

<0030 9073>

Printed in the Philippines